

U.S. FISH AND WILDLIFE SERVICE SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

Scientific Name:

Dalea carthagenensis floridana

Common Name:

Florida prairie-clover

Lead region:

Region 4 (Southeast Region)

Information current as of:

03/26/2013

Status/Action

☐ Funding provided for a proposed rule. Assessment not updated.

☐ Species Assessment - determined species did not meet the definition of the endangered or threatened under the Act and, therefore, was not elevated to the Candidate status.

☐ New Candidate

☒ Continuing Candidate

☐ Candidate Removal

☐ Taxon is more abundant or widespread than previously believed or not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status

☐ Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species

☐ Range is no longer a U.S. territory

☐ Insufficient information exists on biological vulnerability and threats to support listing

☐ Taxon mistakenly included in past notice of review

☐ Taxon does not meet the definition of "species"

☐ Taxon believed to be extinct

☐ Conservation efforts have removed or reduced threats

___ More abundant than believed, diminished threats, or threats eliminated.

Petition Information

___ Non-Petitioned

X Petitioned - Date petition received: 05/11/2004

90-Day Positive:05/11/2005

12 Month Positive:05/11/2005

Did the Petition request a reclassification? **No**

For Petitioned Candidate species:

Is the listing warranted(if yes, see summary threats below) **Yes**

To Date, has publication of the proposal to list been precluded by other higher priority listing?
Yes

Explanation of why precluded:

Higher priority listing actions, including court-approved settlements, court-ordered and statutory deadlines for petition findings and listing determinations, emergency listing determinations, and responses to litigation, continue to preclude the proposed and final listing rules for this species. We continue to monitor populations and will change its status or implement an emergency listing if necessary. The Progress on Revising the Lists section of the current CNOR (<http://endangered.fws.gov/>) provides information on listing actions taken during the last 12 months.

Historical States/Territories/Countries of Occurrence:

- **States/US Territories:** Florida
- **US Counties:** Collier, FL, Miami-Dade, FL, Monroe, FL
- **Countries:**Country information not available

Current States/Counties/Territories/Countries of Occurrence:

- **States/US Territories:** Florida
- **US Counties:** Collier, FL, Miami-Dade, FL, Monroe, FL
- **Countries:**Country information not available

Land Ownership:

Varied, see Tables 1 and 2. There are nine extant occurrences, seven of which are on conservation lands, owned by Miami-Dade County and the National Park Service (NPS). Total acreages are not known.

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Biological Information

Species Description:

Florida prairie-clover is a suffrutescent (having a stem that is woody only at the base; somewhat shrubby) shrub 3-6 feet (0.5-2.0 meters [m]) tall (Bradley and Gann 1999, p. 42; Chafin 2000, NA). Bradley and Gann (1999, p. 42) described it as follows, Leaflets 15-23, ovate to elliptic, 5-14 mm [millimeters] long, glandular punctuate beneath; spikes subcapitate to shortly oblong, 0.5-1.5 (-2) cm long, pubescent; peduncles opposite the leaves, terminal or appearing axillary, 1-3.5 cm [centimeters] long; bracts shorter than calyx; calyx 5-7 mm long, subequal and exceeding the tube, plumose; corolla subpapilionaceous, initially greenish white, turning maroon or dull purple, 4-5 mm long; stamens 9-10 (Adapted from Isely 1990).

Taxonomy:

Bradley and Gann (1999, p. 42) stated, Chapman (1886) was the first to report this taxon in Florida, calling it the tropical *Dalea domingensis*, reporting it for Key Biscayne based on a specimen collected by Curtiss. Small (1903 and 1913) accepted this epithet but included the taxon in the genus *Parosela*, making the plant *P. domingensis*. Rydberg (1920) renamed the plant, calling it *Parosela floridana* . . . In 1933 Small retained this name. In 1946 Clausen reviewed the taxonomy of Florida plants and considered them to be the same as plants of the West Indies. He also found that the name *D. domingensis* was a homonym of *D. emphysoles*, and published the name *D. emphysoles* ssp. *domingensis*. Clausen (1946b) later discovered that his use of the name *D. emphysoles* was in error, and renamed the plants *D. carthagenensis* ssp. *domingensis*. Long and Lakela (1971) accepted this usage. Barneby in 1977, in a monograph of the genus, also found that Florida plants were distinct from West Indian plants, citing differences in leaf characters. He named the Florida plants *D. carthagenensis* var. *floridana*. Wunderlin (1998) has followed this treatment.

The Integrated Taxonomic Information System (2011, p. 1) indicates that the taxonomic standing for *Dalea carthagenensis* var. *floridana* (Rydb.) Barneby is accepted. The online Atlas of Florida Vascular Plants (Wunderlin and Hansen 2008, p. 1) uses the name *D. carthagenensis* var. *floridana*, as does NatureServe (2010, p. 1). The Florida Department of Agriculture and Consumer Services (FDACS) uses the name *Dalea carthagenensis* and notes that *D. carthagenensis* var. *floridana* is endemic (Coile and Garland 2003, p. 17). In summary, there is consensus that *D. carthagenensis* var. *floridana* is a distinct taxon. We have carefully reviewed the available taxonomic information to reach the conclusion that *D. carthagenensis* var. *floridana* is a valid taxon.

Habitat/Life History:

This shrub is found in pine rocklands, edges of rockland hammocks, coastal uplands, and marl prairie (Chafin 2000, NA). Bradley and Gann (1999, p. 42) stated, Fire is probably very important to the livelihood of this taxon. Plants probably do not tolerate shading by hardwoods in the absence of periodic fires. Two of the extirpated occurrences were reported from rockland hammocks (Castellow and Cox Hammocks). Plants probably occurred at the edges of these hammocks. . . At least one of the Palm Beach collections was made in some type of coastal upland.

In 1999, each of the five occurrences known at that time were located in slightly different habitat types: disturbed pine rockland, pine rockland / rockland hammock ecotone, pine rockland / rockland hammock ecotone along road edges, edge of roadside in marl prairie, and ecotone between rockland hammock and marl prairie and flatwoods (Bradley and Gann 1999, p. 43). In 2007, Jimi Sadle (NPS, pers. comm. 2007)

characterized one occurrence in Big Cypress National Preserve (BCNP) at an ecotone between pineland and hammock. Florida prairie-clover occurs in association with *Pinus elliottii* var. *densa* (South Florida slash pine), *Quercus virginiana* (live oak), *Bursera simaruba* (gumbo-limbo), *Metopium toxiferum* (poisonwood), *Sideroxylon celastrinum* (willow bustic), *Eugenia axillaris* (white stopper), *Schizachyrium* spp. (bluestem grasses), and *Paspalum* spp. (paspalum grasses) (Bradley and Gann 1999, p. 43).

Florida prairie-clover appears to be a short-lived (less than 5 years) perennial with a persistent seed bank (Maschinski *et al.* 2010, p. 24). Seedling recruitment varies widely from year to year, with lower recruitment in drier years. Seedlings and juveniles experience rapid growth in their first 2 years (Maschinski *et al.* 2010, p. 21). Although the reproductive biology and ecology of this taxon has not been studied, reproduction is sexual (Bradley and Gann 1999, p. 43). Research by Fairchild Tropical Botanic Garden (FTBG) has shown that scarification has a positive effect on the germination of this plants seeds (Carroll 2005, p. 2). Both concentrated sulfuric acid and boiling water function equally well as scarifying agents; this information can lead to greater success in propagation and reintroduction efforts (Carroll 2005, p. 2).

Historical Range/Distribution:

D. carthagenensis var. *floridana* was historically known from Miami-Dade, Collier, Monroe, and Palm Beach counties. Collections were made in Palm Beach County at an unknown location near Palm Beach by Curtiss in 1895, and south of Palm Beach by Small in 1918. In Monroe County it has been known historically from the Pinecrest region in the Big Cypress National Preserve. It was discovered in Collier County portion of the Big Cypress National Preserve in 1999 (Bradley 1999). (Bradley and Gann 1999, p. 42).

In Miami-Dade County, this plant was reported from many locations, including Key Biscayne, Castellow Hammock, the Charles Deering Estate, R. Hardy Matheson Preserve, the edge of Everglades National Park (ENP), the Coral Gables area, pinelands south of the Miami River, and Cox Hammock (Bradley and Gann 1999, pp. 42-43). There have been no reports of this plant from Palm Beach County since 1918 (Bradley and Gann 1999, p. 42). Gann et al. (2002, pp. 408-411) accounted for essentially every herbarium specimen and reliable sighting. Gann et al. (2006, pp. 2, 12, 32) did not find Florida prairie-clover in ENP, and it is presumed to be extirpated at this location. Previous records (2) at this location may have represented waif (stray) occurrences established on road fill or disturbed soil (Gann et al. 2006, p. 10).

Based upon Bradley and Gann (1999, p. 45) and data from The Institute for Regional Conservation (IRC) (K. Bradley, IRC, pers. comm. 2007), Florida prairie-clover has been extirpated from the sites in Table 1.

Table 1. Extirpated occurrences of Florida prairie-clover.

Current Range Distribution:

This plant is extant at the sites in Table 2 (Bradley and Gann 1999, p. 45; data from IRC [K. Bradley, pers. comm. 2007], data from Florida Natural Areas Inventory [FNAI] (2007, pp. 174-179); A. Jenkins, FNAI, pers. comm. 2007; data from NPS [J. Sadle, pers. comm. 2007, 2011]; data from FTBG [J. Maschinski, FTBG, pers. comm. 2007; J. Possley, FTBG, pers. comm. 2008, pers. comm. 2009, pers. comm. 2011]; Possley and Maschinski 2009, pp. 4-6, 10-12; Maschinski *et al.* 2010, pp. 25-28).

Table 2. Extant occurrences of Florida prairie-clover.

Bradley (pers. comm. 2005a) indicated that he received a report for this species at the Florida Panther National Wildlife Refuge (next to BCNP), but confirmation is needed.

The species was not found during a 2-year project intended to survey and map rare and exotic plants along Florida Department of Transportation (FDOT) right-of-ways within Miami-Dade and Monroe counties (Gordon *et al.* 2007, pp. 1, 37).

Population Estimates/Status:

See Table 2. In 1999, Bradley and Gann (1999, pp. 1-82) provided the Service with a comprehensive report containing status summaries of 12 rockland species in south Florida, including Florida prairie-clover. This was the most complete and comprehensive information at the time and was based upon all available data known to the authors (i.e., the authors own field experience, herbarium specimens, communication with other botanists, published and unpublished literature, FNAI data) (Bradley and Gann 1999, p. 1). Population size of each occurrence of each taxon was estimated using a log₁₀ scale (Bradley and Gann 1999, p. 1). Using this approach, Bradley and Gann (1999, pp. 43, 45) estimated the total population (based on a log₁₀ scale) for Florida prairie-clover to be 101-1,000 plants at five extant sites, with the total population size probably closer to 200 to 300 individuals. Population trend was thought to be probably declining since this plant had been extirpated on many sites where it once occurred (Bradley and Gann 1999, p. 43).

Since that time, a couple of additional occurrences have been found (e.g., Crandon Park, others on private land), and population size estimates have been refined by various entities (e.g., IRC, FNAI, FTBG, and NPS),

depending upon location. FTBG has censused Miami-Dade County natural areas that contain this species in Crandon Park, Charles Deering Estate, and R. Hardy Matheson Preserve (Possley and Maschinski 2009, p. 10). Maschinski (pers. comm. 2007) indicated that 10 woody plants and 4 seedlings occurred at the R. Hardy Matheson Preserve in 2007. Since 2003, the number of woody plants had declined dramatically at this preserve - from 31 to one (Possley and Maschinski 2009, p. 12). Eleven seedlings were found in September 2008 (Possley and Maschinski 2009, p. 12). Overall, the population at this site had performed poorly, likely due to fire suppression for decades (Possley and Maschinski 2009, p. 12). By 2008, only four plants remained leading some to speculate that the population would soon be extirpated (J. Possley, pers. comm. 2008). However, the population rebounded to 50 to 200 plants in 2010, apparently as a result of managers raking away pine straw and using a string trimmer (weed-eater) on competing plants in the immediate area (J. Possley, pers. comm. 2011).

Of 500 plants at the Charles Deering Estate, only 50 are reproductive (J. Possley, pers. comm. 2008). Since 2003, the number of woody plants at this preserve has declined slightly from 51 to 46, but this has been offset by a dramatic increase in seedling establishment (Possley and Maschinski 2009, p. 11). From 2003 to 2005, less than 10 seedlings were recorded, but an estimated 499 seedlings were found in July 2008 (Possley and Maschinski 2009, p. 11). FTBG is uncertain how to explain this increase, but notes that thinning of hardwoods by natural areas management crews may have accelerated seedling establishment (Possley and Maschinski 2009, p. 11). By January 2010, the total population size (seedlings and woody plants) was 356 individuals. The majority of these were seedlings and basal resprouts from a fire that affected approximately one third of the population (Maschinski *et al.* 2010, p. 24).

In 2003, FTBG staff documented a population in coastal uplands at Crandon Park. Florida prairie-clover had not been observed at Crandon Park since 1966 (Maschinski *et al.* 2010, p. 28). The population at Crandon Park appears very healthy, but only occurs in a small area, approximately 145m² (Possley and Maschinski 2009, p. 10). In February 2007, FTBG initiated a demographic study of the population, tagging, measuring, and collecting coordinate locations for each plant within a 3 x 10 m plot. In 2007, 200 plants of various sizes were found within the sampling plot, making the estimated population size in the park 966 plants (J. Maschinski, pers. comm. 2007; Possley and Maschinski 2009, p. 10). During the February 2008 census, FTBG documented 110 plants surviving within the sampling plot from the previous year and 43 new seedlings (Possley and Maschinski 2009, p. 10). It is not known why 90 plants died since 2007, but short lifespan or plant dormancy are possible factors (Possley and Maschinski 2009, p. 10). FTBG used these data to conduct a preliminary population viability analysis (PVA). The results suggest a population that is nearly stable and has a relatively low extinction risk over the next 50 years. Population growth rate (λ) was 0.992 averaged across the years 2007-2009 (Maschinski *et al.* 2010, p. 24). FTBG plans to continue monitoring the study plot annually and hopes to increase understanding about the biology of this species (Possley and Maschinski 2009, p. 10). In 2009, FTBG initiated a seed augmentation experiment at Crandon Park, sowing 3000 seeds in an experiment designed to test the effects of freezer scarification, canopy cover, and associated habitat on the germination and establishment of *Dalea* seedlings. Results from the study are forthcoming (Maschinski *et al.* 2010, p. 27).

In 2006, FTBG provided 25 Florida prairie-clover plants for a dune restoration project at Virginia Key Beach Park. After 8 months, only 4 (16 percent) of the plants had survived. Factors that may have influenced survival include, finer substrate used in beach renourishment, early successional stage of the dune not providing adequate protection from salt spray and wind, erosion leading to burial and washing-out of plants, and competition from early successional dune plants (Maschinski *et al.* 2010, p. 28).

The rounded global status of Florida prairie-clover is considered to be T1, critically imperiled (NatureServe 2010, p. 1). FNAI considers it to be G5T1, meaning the subspecies is critically imperiled globally while the entire species is demonstrably secure globally (FNAI 2011, p. 3). NatureServe (2010, p. 1) indicates that this taxon is restricted to southern Florida, there are fewer than 10 occurrences extant, and several have been extirpated. IRC considers its status to be critically imperiled (Gann *et al.* 2001-2010, p. 1). Florida prairie-clover is listed as endangered by the State.

Threats

A. The present or threatened destruction, modification, or curtailment of its habitat or range:

Most of the Florida prairie-clovers habitat outside of the Big Cypress region has been destroyed by human activity. Residential and commercial development and agriculture have drastically reduced the habitat for this species throughout pine rockland habitats in south Florida. Pine rockland habitat in Miami-Dade County was reduced from 182,780 acres (74,000 hectares [ha]) to about 11 percent of its natural extent by 1996 (20,106 acres (8,140 ha)) (Kernan and Bradley 1996, p. 2). Outside of ENP, only about one percent of the Miami Rock Ridge pinelands escaped clearing and the remaining pinelands are in small, remnant blocks isolated from other natural areas (Herndon 1998, pp. 1-2). Digital mapping of Miami-Dade Countys natural forest communities (NFCs) in 2004 confirmed that Herndons estimate was accurate and also demonstrates that nearly half of the remaining privately owned pinelands had been destroyed or degraded.

Habitat loss continues to occur in the species range, and most remaining suitable habitat has been negatively altered by human activity. Miami-Dade County has developed a network of small public conservation lands and has encouraged conservation of natural vegetation on private land. The Countys actions may have averted extinction of this and other pineland plants. As a result, some opportunities exist to conserve this plant on private land in Miami-Dade County, but there is little opportunity to acquire more conservation lands. Conservation of privately owned pine rocklands in Miami-Dade County is largely a matter of County government cooperation with private landowners, and the County offers incentives for landowners to maintain their NFCs.

Any occurrences and suitable habitat remaining on private land is threatened by habitat loss and degradation, and threats are expected to continue with increases in Floridas human population. The population within Miami-Dade County, which supports the majority of the remaining occurrences for this species, is currently greater than 2.4 million people, and the population is expected to grow to more than 4 million by 2060, an annual increase of roughly 30,000 people (Zwick and Carr 2006, p. 20). While only two known occurrences remain on private land within this county, it is likely that this species will be lost from these sites, with increases in development pressure. Similarly, the likelihood of finding additional suitable habitat in Collier and Monroe Counties is expected to diminish with increases in human population growth in these counties.

Climatic changes, including sea level rise, are major threats to south Florida, this species, and its habitat. The Intergovernmental Panel on Climate Change (IPCC) reports that the warming of the worlds climate system is unequivocal based on documented increases in global average air and ocean temperatures, unprecedented melting of snow and ice, and rising average sea level (IPCC 2007, p. 2; 2008, p. 15). Sea-level rise is the largest climate-driven challenge to low-lying coastal areas and refuges in the sub-tropical ecoregion of southern Florida (U.S. Climate Change Science Program [CCSP] 2008, pp. 5-31, 5-32). The long-term record at Key West shows that sea level rose, on average, 0.088 inches (0.224 cm) annually between 1913 and 2006 (National Oceanographic and Atmospheric Administration [NOAA] 2008, p. 1). This equates to approximately 8.76 inches (22.3 cm) over the last 100 years (NOAA 2008, p. 1).

IPCC (2008, p. 28) emphasized it is very likely that the average rate of sea-level rise during the 21st century will exceed that from 1961 to 2003 (i.e., 0.071 inches [0.18 cm] per year), although it was projected to have substantial geographical variability. Partial loss of the Greenland and/or Antarctic ice sheets could result in many feet (several meters) of sea-level rise, major changes in coastlines, and inundation of low-lying areas (IPCC 2008, pp. 28-29). Low-lying islands and river deltas will incur the largest impacts (IPCC 2008, pp. 28-29). Because dynamic ice flow processes in ice sheets are poorly understood, timeframes are not known; however, modeling indicates that more rapid sea-level rise on century timescales cannot be excluded (IPCC 2008, p. 29). According to CCSP (2008, p. 5-31), much of low-lying, coastal south Florida will be underwater or inundated with salt water in the coming century.

IPCC (2008, pp. 3, 103) concluded that climate change is likely to increase the occurrence of saltwater intrusion into coastal aquifers as sea level rises and that sea-level rise is projected to extend areas of salinisation of groundwater and estuaries, resulting in a decrease of freshwater availability for humans and ecosystems in coastal areas. From the 1930s to 1950s, increased salinity of coastal waters contributed to the decline of cabbage palm forests in southwest Florida (Williams *et al.* 1999, pp. 2056-2059), expansion of mangroves into adjacent marshes in the Everglades (Ross *et al.* 2000, pp. 9, 12-13), and loss of pine rockland in the Keys (Ross *et al.* 1994, pp. 144, 151-155). Hydrology has a strong influence on plant distribution in these and other coastal areas (IPCC 2008, p. 57). Such communities typically grade from salt to brackish to freshwater species. Human developments will also likely be significant factors influencing whether natural communities can move and persist (IPCC 2008, p. 57; CCSP 2008, p. 7-6).

The Science and Technology Committee of the Miami-Dade County Climate Change Task Force (MDCCCTF) (2008, p. 1) recognizes that significant sea level rise is a very real threat to the near future for Miami-Dade County. In a January 2008 statement, the MDCCCTF (2008, pp. 2-3) warned that sea-level is expected to rise at least 3-5 feet (0.9 1.5 m) within this century. With a 3-4 foot (0.9 1.2 m) rise in sea level (above baseline) in Miami-Dade County: Spring high tides would be at about + 6 to 7 feet; freshwater resources would be gone; the Everglades would be inundated on the west side of Miami-Dade County; the barrier islands would be largely inundated; storm surges would be devastating; landfill sites would be exposed to erosion contaminating marine and coastal environments. Freshwater and coastal mangrove wetlands will not keep up with or offset sea level rises of two feet per century or greater. With a five foot rise (spring tides at nearly +8 feet), Miami-Dade County will be extremely diminished, (MDCCCTF 2008, pp. 2-3).

Still, the response by Florida prairie-clover to sea-level rise may not be as clear as that of other species. Possley (pers. comm. 2009) suggested uncertainty regarding the threat of sea level rise to Florida prairie-clover because plants in the coastal strand community in Crandon Park are doing well, and mapping shows that occurrences along the Miami Rock Ridge are all located along the edge of the ridge, which may have been the coastline when sea levels were higher [e.g., during the late Pleistocene].

In summary, all known occurrences are at some risk to habitat loss and modification. Extant occurrences on private land are threatened by development. Most occurrences are in low-lying areas and may be affected by rising sea level. The threats are all ongoing, and thus, imminent. The magnitude of the threat level of habitat loss from development is moderate, since many sites are protected. The magnitude of the threat level of habitat loss from sea-level rise is currently low, but unknown and possibly severe in the future.

B. Overutilization for commercial, recreational, scientific, or educational purposes:

None known.

C. Disease or predation:

Florida prairie-clover is being parasitized by the introduced insect lobate lac scale (*Paratachardina pseudolobata*) at some localities (e.g., R. Hardy Matheson Preserve) (K. Bradley, pers. comm. 2005b). This scale insect is attacking and damaging or killing many native plants and is not yet controlled, despite an active biological control program conducted by the U.S. Department of Agriculture. The threat is imminent, but the magnitude of the threat is not fully known at this time for the Florida prairie-clover.

D. The inadequacy of existing regulatory mechanisms:

The FDACS designated *Dalea carthagenensis* as endangered under Chapter 5B-40, Florida Administrative Code. This listing provides little or no habitat protection beyond the States Development of Regional Impact process, which serves to disclose impacts from projects, but provides no regulatory protection for State listed

plants on private lands. Without local or county ordinances preventing the destruction of the plant, conservation on private lands generally does not occur. Where this species occurs on public conservation lands, existing regulatory mechanisms of those management agencies may be considered adequate on those lands. This threat is imminent, and the magnitude is moderate.

E. Other natural or manmade factors affecting its continued existence:

Exotic plant taxa have significantly affected pine rocklands. As a result of human activities, at least 277 taxa of exotic plants have invaded pine rocklands throughout south Florida (Service 1999, p. 3-175). Brazilian pepper is a serious threat to Florida prairie-clover (Bradley and Gann 1999, pp. 42-43). Exotic plants threaten nearly all extant occurrences (Table 2) (Bradley and Gann 1999, pp. 43-45; K. Bradley, pers. comm. 2007). Bradley and Gann (1999, pp. 42-43) indicated that the control of exotic plants is an important part of habitat maintenance of pine rocklands.

In a recent study to better understand the location and extent of invasive exotic plants and rare native plants along roadways in Miami-Dade and Monroe Counties, 88 (of 121) total targeted exotic plant species were found (Gordon *et al.* 2007, p. 10). Of the road segments surveyed (16,412), 38 percent (6,264) contained at least one exotic plant; some segments contained more than one species of invasive exotic plant (and as many as 15) (Gordon *et al.* 2007, pp. 10-11). In Miami-Dade County, the most frequent naturalized invasive exotic plants recorded were Brazilian-pepper, *Tribulus cistoides* (punctureweed), and *Pennisetum purpureum* (napier grass) (Gordon *et al.* 2007, p. 11).

Fire is required to maintain the pine rockland community, and fire suppression threatens Florida prairie-clover at the majority of sites where it is known to exist (Table 2) (Bradley and Gann 1999, p. 45; K. Bradley, pers. comm. 2007). Under natural conditions, lightning fires typically occurred at 3 to 7-year intervals. With fire suppression, hardwoods eventually invade pine rocklands and shade out understory species like Florida prairie-clover. Fire suppression has reduced the size of the areas that burn, and habitat fragmentation has prevented fire from moving across the landscape in a natural way. Thus, many pine rocklands are gradually becoming tropical hardwood hammocks. Natural fires are unlikely to occur or will likely be suppressed in the remaining highly fragmented pine rockland habitat. Establishment of a natural fire regime at all sites where this species occurs is recommended (Bradley and Gann 1999, p. 43; Chafin 2000, NA). In Miami-Dade County, two preserves supporting the species (Charles Deering Estate and Crandon Park) are scheduled for controlled burns within the next 10 years (Possley and Maschinski 2007, p. 2).

Exotic species have altered the type of fire that occurs in pine rocklands. Historically, pine rocklands had an open, low understory where natural fires remained patchy with low temperature intensity, thus sparing many native plants such as Florida prairie-clover. Dense infestations of *Neyraudia neyraudiana* (Burma reed) and Brazilian pepper cause higher fire temperatures and longer burning periods, such that vegetation maintenance through fire alone will not be possible.

After a period of fire suppression in pine rocklands, it also becomes necessary to control invading native hardwoods mechanically. As with exotics, excess growth of native hardwoods would result in a hot fire that can be destructive. Mechanical treatments cannot entirely replace fire because pine trees, understory shrubs, grasses, and herbs all contribute to an ever-increasing duff layer. When this layer becomes thick, it covers the herbs and prevents most seeds from germinating. Duff will continue to accumulate even if hardwoods are removed mechanically. In addition, the ashes left by fires provide important post-fire nutrient cycling, which is lost with mechanical removal. Florida prairie clover responded with relatively high seedling recruitment (300 new seedlings) after managers raked away duff in the area where the species occurs at R. Hardy Matheson Preserve. No seedlings were recruited in the treatments that did not include raking (Maschinski *et al.* 2010, p. 26). Annual recruitment rates were low and the population was declining prior to the treatment, suggesting that the reduction of the duff layer is important to producing favorable conditions for seedling recruitment.

Management of pine rocklands in Miami-Dade County is further complicated because all of the remnants are small, fragmented areas bordered by urban development. Areas near managed pine rockland that contain exotic species can act as a seed source of exotics allowing them to continue to invade the pine rockland (Bradley and Gann 1999, p. 43). Exotic plant control using labor intensive methods such as hand chopping followed by spot herbicide treatment is feasible at small, intensively managed sites in Miami-Dade County, but not for BCNP. *Melaleuca quinquenervia* (*Melaleuca*) has been a severe problem in BCNP and is now coming under control, but Old World climbing *Lygodium microphyllum* (fern) is spreading southward into ENP and is expected to be present in most of southern Florida in a few years. The R. Hardy Matheson Preserve and Charles Deering Estate have many exotic species and would benefit from removal of exotic plants as part of ongoing maintenance.

Periodic mowing does not appear to have a significant negative impact on Florida prairie clover at two locations along Loop Road in BCNP (J. Sadle, pers. comm. 2007). Plants have been observed in areas that are periodically mowed, and mowing may mimic fire in this case (J. Sadle, pers. comm. 2007). However, changes in mowing practices (more frequent or cessation) may have a negative impact (J. Sadle, pers. comm. 2007).

Off-road vehicle use is a threat to Florida prairie-clover, and damage to plants is a threat to occurrences within BCNP (Bradley and Gann 1999, pp. 42-45; K. Bradley, pers. comm. 2005a). Biologists have noted that plants are attempting to recruit in these trails and are being crushed (K. Bradley, pers. comm. 2005a). Plants occur along the edges of an off-road vehicle trail and can be easily damaged (Bradley and Gann 1999, p. 43). Operators frequently veer off established trails, and plants can be harmed or destroyed (Bradley and Gann 1999, p. 43). BCNP manages off-road vehicle access using a permit system, regulations, and designated trails. Damage from vehicles is also a threat at the Charles Deering Estate (J. Possley, pers. comm. 2008, 2009). Plants occur along the edge of a service road, so damage from vehicles is expected (J. Possley, pers. comm. 2008).

Plants at the R. Hardy Matheson Preserve are threatened by illegal mountain biking (Bradley and Gann 1999, pp. 43-45). In the past, this pineland fragment was heavily used by mountain bikers. The Miami-Dade County Parks and Recreation Department has erected fencing to protect this site, but it is still illegally accessed on occasion (Bradley and Gann 1999, p. 43). Overall, this threat appears to have been reduced.

Catastrophic events such as hurricanes or tropical storms may negatively impact the species by altering the vegetation composition or water levels, or creating masses of urban debris that may be illegally disposed of in remnant pinelands. According to the National Oceanographic and Atmospheric Administration, Miami-Dade County, the Keys, and western Cuba are the most storm-prone areas in the Caribbean so this threat is expected to continue.

Only nine occurrences of Florida prairie clover remain, seven of which are on conservation lands. There is one additional reintroduced occurrence, consisting of four plants, at Virginia Key Beach Park (Maschinski *et al.* 2010, p. 28). The species range is restricted and there are a small number of plants at most sites. Although no population viability analysis has been conducted for this plant, indications are that most existing occurrences are not viable, at least in Miami-Dade County. As a result, threats associated with small population size are present. These include potential vulnerabilities from environmental (catastrophic hurricanes), demographic (potential episodes of poor reproduction), and genetic (potential inbreeding depression) threats.

In summary, Florida prairie-clover is vulnerable to a wide array of natural and human factors, including: exotic plants, fire suppression, off-road vehicle use and mountain biking, illegal dumping, hurricanes and extreme weather events, storm surges, small and isolated occurrences, and restricted range. These threats are imminent. The overall magnitude of these threats is high.

Conservation Measures Planned or Implemented :

In 1979, Miami-Dade County enacted the Environmentally Endangered Lands Covenant Program, which reduces taxes for private landowners of pine rocklands and tropical hardwood hammocks who agree to not develop their property and manage it for a period of 10 years (Service 1999, p. 3-177). Miami-Dade County also purchases NFCs, including tropical hammocks and pine rocklands.

The Miami-Dade Forest Resources Program has regulatory authority over pine rocklands and tropical hardwood hammocks and is charged with enforcing regulations that provide partial protection on the Miami Rock Ridge (Service 1999, p. 3-177). This includes authority over all NFCs in the county, including county- and city-owned parcels (Service 1999, p. 3-177).

Studies on demography are being conducted by FTBG at the R. Hardy Matheson Preserve (Carroll 2005, p. 1).

In 2005, the Service funded IRC through the Private Stewardship Grant Program to facilitate restoration and management of privately owned pine rockland habitats in Miami-Dade County. Restoration efforts include exotic plant control, light debris removal, hardwood management, and reintroduction of pines. Management plans include recommendations for prescribed burning, debris cleanup, exotic animal control, and hydrological restoration. This project has been completed. Although Florida prairie-clover did not occur on any pine rocklands that were restored, it could be introduced into one of these sites in the future.

In 2006, FTBG provided 25 Florida prairie-clover plants for a dune restoration project at Virginia Key Beach Park. After 8 months, only 4 (16 percent) of the plants had survived. Factors that may have influenced survival include, finer substrate used in beach renourishment, early successional stage of the dune not providing adequate protection from salt spray and wind, erosion leading to burial and washing-out of plants, and competition from early successional dune plants (Maschinski et al. 2010, p. 28).

In 2007, the Service funded IRC to implement conservation activities associated with three candidate plant species on pine rockland fragments in Miami-Dade County in private ownership. The objective of this project is to restore suitable habitat and reintroduce and establish new populations of the plants in pine rocklands. While this project does not specifically target Florida prairie-clover, there is potential for benefit to this species as a result of habitat restoration.

In 2008, the Service funded IRC to conduct reintroductions of one federally listed endangered plant species and four Federal candidate plant species on publicly owned pine rockland preserves in Miami-Dade County. The goal is to increase the number of occurrences of listed and candidate plant species to help implement recovery efforts and decrease risk of extinction. Target species included: Florida prairie-clover, *Chamaesyce deltoidea* spp. *deltoidea* (deltoid spurge), *Brickellia mosieri* (Florida brickell-bush), *Linum arenicola* (sand flax), and *Linum carteri* var. *carteri* (Carters small-flowered flax). Reintroductions will attempt to establish new occurrences of each species and increase population sizes. Working with a variety of partners, IRC is making progress with prescribed fire, plant cultivation, and reintroduction to select sites (Bradley and van der Heiden 2013, pp. 2-6). In April 2009, IRC began cultivation of 8 cuttings and 20 seeds using germplasm obtained from the Charles Deering Estate (Bradley et al. 2009, p. 4). A variety of growing media and soil amendments are being tested during the cultivation process to maximize success (Bradley et al. 2009, pp. 2-3). In July 2009, IRC successfully conducted its first prescribed fires at the George N. Avery Pineland and John Kunkel Small Pineland (Bradley and van der Heiden 2013, p. 4). In the years since fire, follow-up management has occurred on both sites, including removal of non-native species to improve the health of the ecosystem (Bradley and van der Heiden 2013, p. 4).

In 2009, FTBG initiated a seed augmentation experiment at Crandon Park, sowing 3000 seeds in an experiment designed to test the effects of freezer scarification, canopy cover, and associated habitat on the germination and establishment of seedlings. Results from the study are forthcoming (Maschinski et al. 2010, p. 27).

In addition, the Services Coastal and Partners for Fish and Wildlife Programs are also pursuing similar habitat restoration projects, which could help improve the status of the species. In 2009, \$400,000 of stimulus funding was allocated for habitat restoration in Miami-Dade County through the Coastal program as part of the Pine Rockland Initiative (D. DeVore, Service, pers. comm. 2010). The Partners for Fish and Wildlife program is also supporting similar habitat restoration projects in Miami-Dade County.

FTBG maintains an ex situ collection of 152 plants in their nursery, including 21 individuals grown from seed collected at R. Hardy Matheson Preserve (Possley and Maschinski 2009, p. 12). FTBG has collected nearly 17,000 seeds for use in germination trials and to send to the National Center for Genetic Preservation (Possley and Maschinski 2009, p. 12). Germination trials indicated that seeds are orthodox and will germinate at close to 100 percent with scarification from a blade or acid or by freezing (Possley and Maschinski 2009, p. 12).

The FDOT collaborated on and funded a study of the approximately 650 miles (1,046 kilometers) of FDOT roadway in Miami-Dade and Monroe counties (District 6) (Gordon *et al.* 2007, pp. 1, 3). The study was conducted by The University of Florida, in collaboration with IRC and the FNAI to survey and map exotic and rare native plants along FDOT right-of-ways within Miami-Dade and Monroe counties and to create a database that can be updated to reflect future activities and conditions (Gordon *et al.* 2007, pp. 1, 3).

Summary of Threats :

There are nine extant occurrences of Florida prairie-clover; most are on conservation land. Existing occurrences are extremely small and may not be viable, especially some in Miami-Dade County. Remaining habitats are fragmented. Climatic changes, including sea level rise, are long-term threats that will continue; these factors are expected to ultimately reduce the extent of available habitat. This species is threatened by habitat loss and degradation due to fire suppression, the difficulty of applying prescribed fire to pine rocklands, and threats from exotic plants (Bradley and Gann 1999, pp. 42-45; NatureServe 2010, pp. 1-2). Damage to plants by off-road vehicles is a serious threat to occurrences within BCNP; the threat from illegal mountain biking at the R. Hardy Matheson Preserve has been reduced (Bradley and Gann 1999, p. 43). Changes in mowing practices (more frequent or cessation) may have a negative impact on plants at one location within BCNP (J. Sadle, pers. comm. 2007). This species is being parasitized by the introduced insect lobate lac scale at some localities (e.g., R. Hardy Matheson Preserve), but we do not know the extent of this threat. Florida prairie-clover is vulnerable to natural disturbances, such as hurricanes, tropical storms, and storm surges. Due to its restricted range and the small sizes of most isolated occurrences, this species is vulnerable to environmental (catastrophic hurricanes), demographic (potential episodes of poor reproduction), and genetic (potential inbreeding depression) threats. We find that this species is warranted for listing throughout all of its range, and, therefore, find that it is unnecessary to analyze whether it is threatened or endangered in a significant portion of its range.

For species that are being removed from candidate status:

_____ Is the removal based in whole or in part on one or more individual conservation efforts that you determined met the standards in the Policy for Evaluation of Conservation Efforts When Making Listing Decisions(PECE)?

Recommended Conservation Measures :

Conserve pine rocklands and suitable habitat through purchase or conservation easements.
Restore understories by removing exotic plants or hardwoods.
Provide regular prescribed burns to sites to maintain suitable habitat conditions.
Monitor and manage the remaining small populations in Miami-Dade County.
Consider and conduct augmentation and reintroduction, at suitable sites (Maschinski *et al.* 2005, p. 165).
Conduct additional surveys in the Big Cypress region, including Florida Panther National Wildlife Refuge.

Monitor known populations.

Investigate ways to increase population viability.

Study the introduced insect lobate lac scale to determine the extent of this threat and identify any necessary actions.

Conduct studies to determine current level of genetic variation remaining in extant occurrences.

Research presence and longevity of seed banks in different habitats.

Priority Table

Magnitude	Immediacy	Taxonomy	Priority
High	Imminent	Monotypic genus	1
		Species	2
		Subspecies/Population	3
	Non-imminent	Monotypic genus	4
		Species	5
		Subspecies/Population	6
Moderate to Low	Imminent	Monotype genus	7
		Species	8
		Subspecies/Population	9
	Non-Imminent	Monotype genus	10
		Species	11
		Subspecies/Population	12

Rationale for Change in Listing Priority Number:

Magnitude:

There are nine extant occurrences of Florida prairie-clover; most are on conservation land. Habitat loss and degradation due to development is still a threat on the few private lands that support this plant or suitable habitat; this threat is considered moderate. Climatic changes, including sea level rise, are long-term threats that may reduce the extent of habitat. Lack of regulatory mechanisms is a concern on private lands; this threat is considered moderate. Nearly all remaining occurrences are threatened by fire suppression, difficulty in applying prescribed fire, and exotic species; these threats are considered high. Damage by off-road vehicles is a serious threat to the occurrences (three) within BCNP. One additional occurrence is threatened by illegal mountain biking; this threat is considered to be low. One location within BCNP is threatened by changes in mowing practices; this threat is considered to be low. This species is being parasitized by the introduced insect lobate lac scale at some localities, but we do not know the extent of this threat. This species is vulnerable to natural disturbances, such as hurricanes, tropical storms, and storm surges. Due to the small and fragmented nature of the current population, stochastic events, disease or genetic bottlenecks may strongly affect this species. Although no population viability analysis has been conducted, each occurrence of this species is extremely small; indications are that most existing occurrences may not be viable. Overall, the magnitude of threats is high.

Imminence :

Habitat loss and degradation due to development is a threat for those occurrences on private lands, but seven

occurrences are protected from this threat. Threats from development are considered imminent on private lands. Sea level rise is currently occurring and has resulted in the loss of pine rocklands. However, this is considered a long-term threat since we do not have evidence that it is currently affecting any population. We are also uncertain of the extent to which sea-level rise constitutes a threat to this species. Nearly all occurrences are currently threatened by one or more of the following factors: fire suppression, difficulty in applying prescribed fire, exotic species, or incompatible management practices. Urban conservation lands where this species occurs require regular maintenance; some efforts are underway to use prescribed fire and control exotics on public and private lands. These threats are considered imminent. Threats from the insect lobate lac scale at some localities are currently occurring, but we do not know the extent of this threat. Damage by off-road vehicles to occurrences within BCNP is a serious threat; this is occurring and considered imminent. Threats due to illegal mountain biking have been reduced; this is considered non-imminent. The threat of changes in mowing practices is considered non-imminent. The threat from hurricanes is considered non-imminent since occurrences are separated geographically. Problems associated with small and isolated populations are currently occurring. All indications are that Florida prairie-clover does not currently exist in sufficient numbers to have viable populations, even if all the sites on conservation lands are well managed. Overall, the immediacy of threats is imminent.

Yes Have you promptly reviewed all of the information received regarding the species for the purpose of determination whether emergency listing is needed?

Emergency Listing Review

No Is Emergency Listing Warranted?

No. This plant persists on several conservation lands. With proper management, some threats to this species can be removed or reduced.

Description of Monitoring:

Monitoring for this species is not being actively or regularly conducted at most sites. However, FTBG has periodically censused natural areas that contain this species in Miami-Dade County. In 2007, FTBG initiated new demographic studies at Crandon Park; monitoring has been conducted at the Charles Deering Estate and R. Hardy Matheson Preserves since 2003 (Possley and Maschinski 2009, pp. 10-12).

The Service recently completed a project with IRC and Miami-Dade County to map public and many private NFCs for the Countys geographic information system. This project provided a list of plant species for each site. The project enables the County to manage information on pinelands and detect changes in their extent.

Indicate which State(s) (within the range of the species) provided information or comments on the species or latest species assessment:

none

Indicate which State(s) did not provide any information or comment:

Florida

State Coordination:

The Service requested new information (observations, data, reports) regarding the status of this plant or any new information regarding threats to this species from: FDACS, NPS, Service (National Wildlife Refuges), Florida Department of Environmental Protection, Miami-Dade County, Florida Fish and Wildlife Conservation Commission, FNAI, IRC, Historic Bok Sanctuary, The Nature Conservancy, FTBG, Archbold

Biological Station, NatureServe, University of Central Florida, Florida International University, University of Florida, Princeton, members of the Rare Plant Task Force, botanists, and others. In total, the previous assessment was sent to approximately 200 individuals. All new information, data, and comments have been incorporated.

The State of Florida does not specifically list plants in its State Wildlife Action Plan.

No new data or comments were received from the State for this assessment. Information and data previously provided have been incorporated into this assessment.

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Approval/Concurrence:

Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes, including elevations or removals from candidate status and listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all resubmitted 12-month petition findings, additions or removal of species from candidate status, and listing priority changes.

Approve:



07/15/2013

Date

Concur:



10/28/2013

Date

Did not concur:

Date

Director's Remarks: